Biological Survey of receiving waters for proposed wastewater discharge, Iris River

Peter E Davies and Laurie Cook,
Freshwater Systems

1. Introduction

This document reports on an assessment of the aquatic biological values of the upper Iris River, and the implications and risks associated with a proposal to discharge treated wastewater from the Cradle Valley area.

A review of existing data and literature for the area was conducted, followed by a field survey of aquatic macroinvertebrates, plants and fish. The survey was conducted at three sites in the Iris River at and downstream of the proposed discharge location, one 'reference' site upstream in the Iris, and two 'reference' sites in the adjacent Fall River.

The biological data was reviewed to assess:

- the presence of any threatened species listed under the Tasmanian Threatened Species Protection Act (TSPA, 1995) and/or the Environmental Protection and Biodiversity Conservation Act (EPBCA, 1999);
- the presence of any special biological values or biodiversity issues;
- the ecological condition of the stream sites;
- the presence of any other impacts or threatening processes.

The field data was also collected in such a manner as to provide a dataset as a basis for future monitoring. Thus, both qualitative and quantitative sampling methods were used.

An overall assessment of conservation status of the Iris River downstream of the proposed discharge point was conducted using three criteria identified by Dunn (2000) and now used within the development of DPIWE's framework for conservation of freshwater ecosystem values (CFEV). These criteria are:

- naturalness

- distinctiveness
- representativeness.

These criteria were used to assess the aquatic biological data and identify any risks to the aquatic environment that may result from the proposed discharge.

2. Methods

2.1 Data/literature review

Published literature and unpublished technical reports were reviewed to asses the availability of any information on aquatic fauna/flora from the Isis River and adjoining catchments. In addition, GTSPOT records were examined for any threatened species or the aquatic fauna/flora records.

2.2 Field sampling

2.2.1 Fish

All sites were sampled by backpack electrofishing (using a Smith-Root backpack electroshocker). A 100 m reach was sampled by two people, with three passes of the reach conducted at each site. All fish from each pass were identified, counted and measured (fork length to the nearest mm) prior to release.

2.2.2 Macroinvertebrates

All sites were sampled quantitatively and qualitatively for benthic macroinvertebrates.

Quantitative sampling: 10 'surber' samples were taken at each site, by hand disturbance of the stream substrate within a 33 x 33 cm ($0.11m^2$) quadrat immediately upstream of the sampler net (500 micron mesh size)to a depth of ca 10 cm. The 10 sample units were pooled and preserved with 10% formalin prior to transport to the laboratory.

Processing of quantitative samples consisted of elutriation of the material in a saturated calcium chloride solution, with scanning of the remaining sand-gravel material. The elutriated material was then sub-sampled to 20% with the Marchant box subsampler, with one 20% subsample collected for processing from each sample. The subsample was then hand sorted under magnification, with all individuals picked counted and identified to family level (except for flatworms, true worms, mites, gordiids, nematodes and hydrozoa). Chironomids were identified to sub-family. The following groups, for which good taxonomic information was available, and within which the majority of listed species occur were then identified to species: mayflies

(Ephemeroptera), stoneflies (Plecoptera), caddis (Trichoptera), crustaceans (Amphipoda, Isopoda), and beetles (Coleoptera). Molluscs were identified to genus or species or genus.

Qualitative sampling: Two, replicate, rapid bioassessment (RBA) samples were taken at each site from the (dominant) riffle habitat. One 10 m length of riffle was sampled by kicking substrate upstream of a standard 250 micron mesh kick net, with the material captured in the net comprising a single RBA sample. Each sample was hand sorted on-site, using the Tasmanian AUSRIVAS sample processing protocol, picking for ca 30 - 45 minutes to ensure collection of at least 150 – 200 individuals. The picked material was preserved in 90% ethanol-glycerol in vials prior to processing in the laboratory. All animals were counted and identified in the laboratory under magnification to 'family' level as described above.

2.3 Analysis

The data collected from the Iris River sites downstream of the Cradle Road were assessed against three criteria: distinctiveness, naturalness and representativeness.

Distinctiveness:

Threatened/distinctive species

All samples were evaluated for the presence of any species listed under the TSPA or EPBCA.

Unique species/community composition

All samples from the Iris river downstream of the Cradle Road (the reach potentially affected by the proposed discharge) were compared with the reference site samples in terms of:

- overall similarity of composition of biological communities;
- presence of any species unique not present in the reference sites or elsewhere;
- unusually high biodiversity.

Naturalness

The qualitative (RBA) data from each site were analysed using the AUSRIVAS/RIVPACS technique (the AUStralian RIVer Assessment Scheme, see

Davies and Schofield 1996). The most sensitive relevant AUSRIVAS model available for this area was used – the autumn season riffle AUSRIVAS model based on rank abundance data (developed by Dr Davies for DPIWE's Water Assessment Branch).

This approach allows the macroinvertebrate fauna at the sites to be formally compared with a list of taxa (and their relative abundance) expected to occur if the site was in reference condition. It generates an index called O/E (observed over expected), which ranges between zero (none of the taxa expected to occur actually being found at the site), indicating extremely impaired conditions, to around 1 (when al taxa expected to occur are actually found), indicating that the site is in reference (unimpaired) condition. O/E scores are often reported in relation to 'band' of impairment, with scores between 0.75 and 1.18 falling into the unimpaired (equivalent to reference) band for the AUSRIVAS model used here. Sites with scores falling within this band are generally considered to be in close to natural conditions in most parts of Tasmania.

In addition, the composition of the fish fauna was assessed for the presence of alien species, which would indicate a departure from natural conditions.

Representativeness

The composition of the Iris River aquatic fauna was assessed against the sampled reference sites and against the overall composition of stream fauna from the AUSRIVAS data set, by inspection of O/E values. The Iris River fauna was also compared informally with the taxa recorded in previous surveys in and adjacent to the World Heritage Area.

3. Results

3.1 Data/literature review

There is no published literature on the aquatic fauna of the Iris River. The following records were obtained from a variety of sources:

Species	Common name	Source
Salmo trutta	Brown trout	IFS
Conoesucus nepotulus	Caddisfly	GTSPOT, J Jackson
C. digitiferus	"	
C. brontensis	"	
C. fromus	"	
Costora delora	"	
Costora dark	"	
Lingora aurata	"	
Matasia satana	"	
Alloecella longispina	"	

3.2 Survey

3.2 1 Sites

The location of the sites surveyed are shown in Figure 1, and in Table 1 along with observations of the presence of two impacts – cattle and trout. The sites experiencing the greatest impact, primarily due to unrestricted cattle access, were the Iris at the Link Road bridge and the two Fall River sites.

Table 1. Details of sites surveyed in April 2003.

River	Site	Easting	Northing	Land status	Cattle impact?	Fish (trout)?
Iris	Upstream	411400	5398200	Crown	Little/none	Sparse
	Cradle Rd	412300	5398150	Private	Slight	Many
	Link Rd	413400	5399300	Private	Yes	Many
	Downstream	415900	5400900	Private	Some	Many
Fall	Upstream	410500	5400450	Private	Yes	None
	Downstream	414800	5402900	Private	Yes	Many

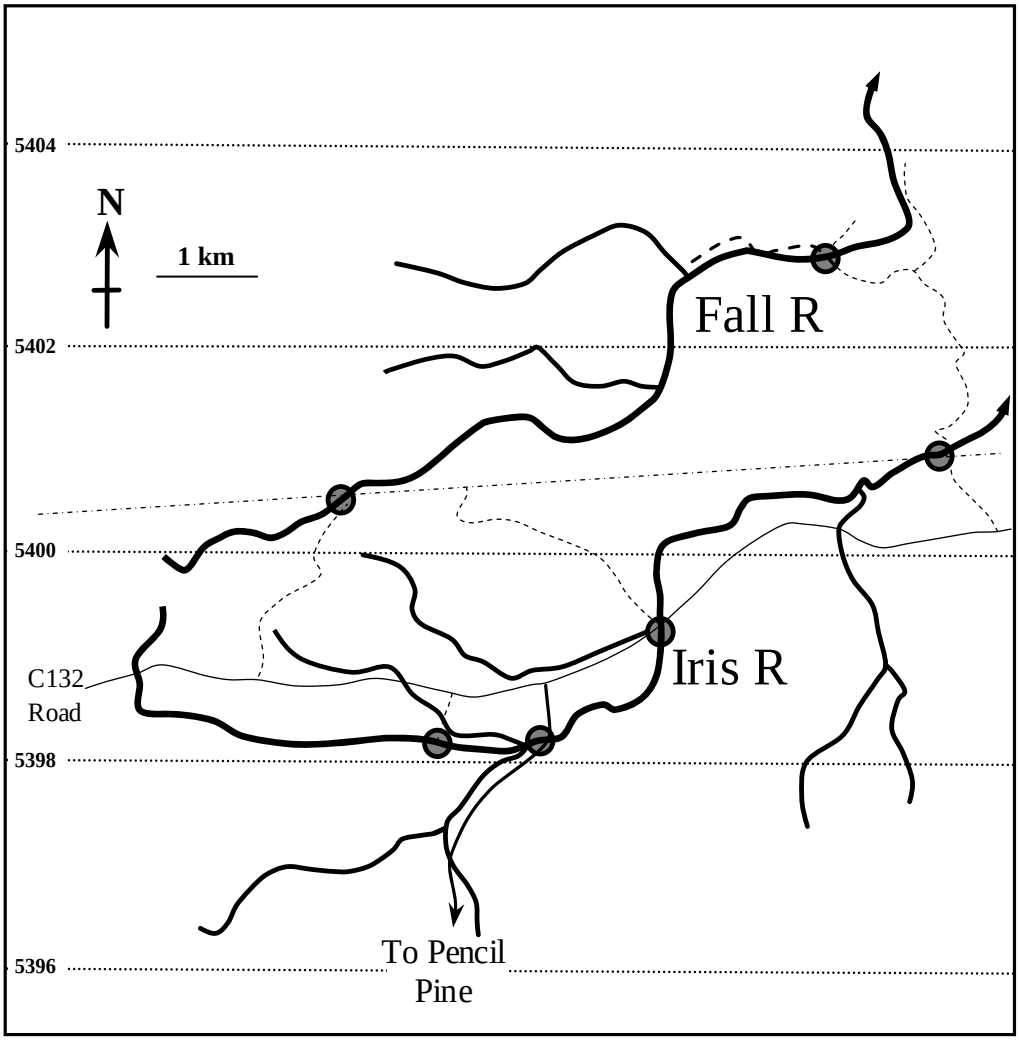

Figure 1. Map of survey area, showing sample sites (filled circles, see Table 1), streamlines, roads (-) and tracks (- -), and transmission line (- . -). Gridlines indicate northings.

3.2.2 Fish

The results of fish surveys are shown in Table 2. Only one species, the alien *Salmo trutta*, brown trout, was recorded. The upper Falls River had no trout, due to a small waterfall between this and the downstream site, and the upper Iris had few trout, largely due to the braided, shallow nature of the channel complex in this section. The remaining sites had moderate to high densities of brown trout.

Three sites showed high levels of recruitment, represented by a high proportion of the population being made up of young of the year (< 100mm fork length). The downstream Iris site only contained older fish, suggesting that recruitment for the Iris downstream of the link Road comes from the upper reaches. This matches well with the distribution of gravel substrate in the system, which are required for spawning and successful production of young.

Overall, the sites are considered impacted due to the presence of trout and the absence of native fish species. The upper Falls River is of particular interest due to the natural absence of fish, a product of the downstream barrier.

3.2.3 Macroinvertebrates

Macroinvertebrate communities in this area are dominated by three taxa: chironomiin midges, worms and mayflies, which comprised 43% of the overall abundance from all sites. The gripopterygid stoneflies, baetid mayflies and conoesucid caddis comprised a further 21% of the total abundance. This composition reflects an abundant, fauna typical of upland, good quality habitat streams with low to moderate gradients.

The results of the quantitative (surber) and qualitative (RBA) sampling is shown in Table 3 and 4, at family level. The species identified from the surber samples are shown in Table 5. In this table, the 15 species observed only in the Iris River downstream of Cradle Road bridge and not in the reference sites sampled are shown in bold. Only one species recorded, *Oxyethira mienica*, is listed, under the TSPA. A single specimen was found, in the Fall River. The species is now considered widespread, due to recent large scale species collection, and may even be considered for de-listing at some stage in the near future.

Table 2. Fish survey details (numbers, calculated total abundance, fish lengths) at all sites surveyed in April 2003.

River	Iris			Iris			Iris			Iris			Fall			Fall		
Site	Upstream			Cradle Rd			Link Rd			Downstream			Upstream			Downstream		
Date	7/4/99			7/4/99			7/4/99			8/4/99			8/4/99			8/4/99		
Pass	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Fork lengths	65	no fish	no fish	60	65	115	75	155	64	110	155	no fish	no fish	no fish	no fish	85	78	75
(mm)	123			65	73	120	95	176	135	165	180					90	82	80
				65	75	135	95	178	165	170	180					95	85	
				65	145	140	130	187		170	190					95	86	
				65	175	145	135	189		175	190					170	88	
				65	175	145	140			180						185	238	
				65	195	230	140			190								
				70	205		140			195								
				70	220		145			195								
				100	235		145			195								
				112			153			215								
				115			160			275								
				125			164			295								
				125			165											
				130			165											
				130			168											
				135			180											
				135			182											
				135			186											
				137			200											
				138			207											
				138			212											
				140			216											
				142														
				145														
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				195														
				195														
				200														
				210														
				215														
				215														
				225														
				240														
				245														
				255														
N	2	0	0	47	10	7	23	5	3	13	5	0	0	0	0	6	6	2
Total N		2			64			31			18			0			14	
Population		**2**			**65**			**31**			**18**			**0**			**16**	
Standard error		0.21			1.82			0.94			0.51						3.49	

Table 3. Quantitative (surber) benthic macroinvertebrate family data (numbers as n/0.18m²) from all sites surveyed in April 2003.

		River:	Iris River				Fall River	
		Site:	Upstream	**Cradle Rd**	**Link Rd**	**Downstream**	Upstream	Downstream
		Date:	7/4/99	7/4/99	7/4/99	8/4/99	8/4/99	8/4/99
Class	**Order**	**Family**						
Cnidaria	Hydrozoa		27	3				
Platyhelminthes	Turbellaria		2	9	5	1		2
Nematoda			5	1				7
Mollusca	Gastropoda	Hydrobiidae	84	2	4			1
		Ancylidae		2				
Annelida	Hirudinea						2	
	Oligochaeta		184	39	150	78	2	296
Arachnida	Acarina		2	6	1	1	2	4
Crustacea	Amphipoda	Paramelitidae	9		1	3	21	3
	Isopoda	Janiridae		1				
	Ostracoda		50					
Insecta	Collembola		2					
	Plecoptera	Eustheniidae	1	3	6	16	9	16
		Austroperlidae	1	5				4
		Gripopterygidae	62	85	153	8	99	94
		Notonemouridae	171	1	9	1	6	6
	Ephemeroptera	Leptophlebiidae	56	50	76	275	155	127
		Oniscigastridae	1					
		Baetidae	4	20	73	185	5	100
	Odonata	Telephlebiidae			1			2
	Diptera	Chironomidae :						
		sub.fam. Chironominae	38	7	34	51	5	880
		sub.fam. Orthocladiinae	26	29	65	17	50	130
		sub.fam. Podonominae		2			5	
		sub.fam. Tanypodinae	9					
		sub.fam. Diamesinae			1			
		Simuliidae	5	8	3	2	15	5
		Tipulidae			1	3		
		Athericidae		5		2	4	30
		Ceratopogonidae	2			2		
		Empididae	1	2	2		1	7
		Ephydridae	1					
		Unid. pupae	2	5	5	1	2	8
	Trichoptera	Calocidae	6	1	3	3	1	1
		Conoesucidae	2	63	80	44	122	25
		Glossosomatidae		4				
		Helicophidae		7	4		22	4
		Helicopsychidae				2		
		Hydrobiosidae	18	10	16	12	7	27
		Hydropsychidae	3	18	64	41	30	30
		Hydroptilidae			1	4	1	
		Leptoceridae	1	2	25	16	3	9
		Philorheithridae	1	3	4	7	10	4
		Unid. pupae		2				
	Coleoptera	Adult Elmidae	23	26	20	21	8	11
		Larval Elmidae	58	35	26	57	21	23
		Larval Scirtidae	72	18	28	93	20	34
		Larval Psephenidae	36	4	4	6	15	1
		N taxa ('family' only) :	**34**	**34**	**30**	**28**	**28**	**30**
		Total abundance :	**965**	**478**	**865**	**952**	**643**	**1891**
		N taxa total (species + family) :	**44**	**48**	**52**	**48**	**50**	**42**

Table 4. Quantitative (surber) benthic macroinvertebrate species data (numbers as n/0.18m2) from all sites surveyed in April 2003.

		River:	Iris River				Fall River	
		Site:	Upstream	Cradle Rd	Link Rd	Downstream	Upstream	Downstream
		Date:	7/4/99	7/4/99	7/4/99	8/4/99	8/4/99	8/4/99
Order	**Family**	**Species**						
Gastropoda	Hydrobiidae	*Beddomeia sp.*	5	2	3			
		Fluvidona sp.	10		1			
Amphipoda	Paramelitidae	*Austrogammarus telsosetosus*	9		1	3	21	3
Plecoptera	Eustheniidae	*Eusthenia costalis*			1	1		16
		Eusthenia spectabilis	1	3	5	15	9	
	Austroperlidae	***Cryptoperla paradoxa***		5				
		Tasmanoperla thalia	1					4
	Gripopterygidae	*Cardioperla media/lobata*	8	4			4	
		Cardioperla spinosa	5	64	99	5	81	45
		Dinotoperla marmorata	2	2	5		3	1
		Leptoperla beroe					2	
		Leptoperla varia	47	15	47	3	8	45
		Trinotoperla tasmanica					1	
		Trinotoperla zwicki			2			3
	Notonemouridae	*Austrocercoides sp*	171	1	9	1	6	6
Ephemeroptera	Leptophlebiidae	***Austrophlebioides sp. AV4***			12	93		
		Austrophlebioides sp. AV7		1	1			
		Nousia sp. AV5	3	13	2	20	4	2
		Nousia sp. AV7	38	26	29	145	94	109
		Nousia sp. AV9	14	9	32	15		14
		Tillyardophlebia sp AV2	1	1		2		2
		New species					57	
	Baetidae	*Baetid Genus 2 MV sp. 3*	4	20	73	185	5	100
	Oniscigastridae	*Tasmanophlebia sp.*	1					
Odonata	Telephlebiidae	*Austroaeschna tasmanica*			1			2
Trichoptera	Calocidae	*Caenota plicata*	1					
		Tamasia variegata	5	1	3	3	1	1
	Conoesucidae	***Conoesucus brontensis***			5	3		
		Conoesucus digitiferus			3		6	23
		Conoesucus fromus			1	1	11	2
		Conoesucus nepotulus	2	6	30	8	25	
		Conoesucus sp. AV6					64	
		Conoesucus sp. AV7		12				
		Costora delora		3	3	1		
		Costora luxata					6	
		Costora rotosca		1				
		Costora seposita					10	
		Lingora aurata		17	37	2		
		Matasia satana		24	1	29		
	Glossosomatidae	***Agapetus sp. AV1***		4				
	Helicophidae	*Alloecella longispina*		7	4		21	4
		Alloecella pilosa					1	
	Helicopsychidae	***Helicopsyche murrumba***				2		
	Hydrobiosidae	*Apsilochorema obliquum*				1	1	
		** Ethochorema brunneum*		1			1	1
		Genus Hydb B sp. AV2	1				1	
		Moruya opora						6
		Taschorema complex, includes *	4	5	8	7	2	13
		** Taschorema apobamum*		2	1	1		1
		** Taschorema asmanum*			1			2
		** Taschorema evansi*	13					
		** Taschorema ferulum*		1		2	2	
		** Taschorema sp. AV1*			3			4
		Ulmerochorema rubiconum		1	3	1		
	Hydropsychidae	*Asmicridea sp. AV1*	3	18	64	40	1	
		Smicrophylax sp. AV3				1	29	30
	Hydroptilidae	***Hellyethira cubitans***			1	4		
		Oxyethira mienica					1	
	Leptoceridae	*Notalina bifaria*	1		23	7	2	
		Notalina sp. AV1		2	2	9		9
		Triplectides proximus					1	
	Philorheithridae	*Tasmanthrus angustipennis*	1	3	4	7	10	4
Coleoptera	Adult Elmidae	*Austrolimnius sp.*	23	26	11	13	7	11
		Kingolus sp.			9	8		
		Simsonia sp.					1	
	Larval Elmidae	*Austrolimnius sp.*	56	23	7	34	7	17
		Kingolus aeratus	2		15	16	1	2
		Notriolus simsoni					5	
		Simsonia leai		12	4	3	8	4
		Simsonia sp.L12E				4		
	Larval Psephenidae	*Sclerocyphon secretus*	36	4	4	6	15	1
		N species :	**29**	**35**	**42**	**38**	**40**	**32**

Table 5. Qualitative (RAP) benthic macroinvertebrate survey results for all families (numbers as n per 10m kick live-pick) from all sites surveyed in April 2003.

			River:	Iris River								Fall River			
			Site:	Upstream		Cradle Rd		Link Rd		Downstream		Upstream		Downstream	
			Date:	7/4/99		7/4/99		7/4/99		8/4/99		8/4/99		8/4/99	
Class	Order	Family	Rep :	1	2	1	2	1	2	1	2	1	2	1	2
Platyhelminthes	Turbellaria			1		1	1		1						
Nematoda					1										
Mollusca	Gastropoda	Hydrobiidae		1	1	2									
Annelida	Oligochaeta				1	4		5	3		6	1		4	
Arachnida	Acarina					6	1		2			2	7		2
Crustacea	Amphipoda	Paramelitidae		22	22	1				2		6	4	2	1
	Ostracoda											1			
Insecta	Collembola									1					
	Plecoptera	Eustheniidae		2	1	2	5	6	2	6	14	2	2	9	10
		Austroperlidae		4	1					1	1				3
		Gripopterygidae		15	11	33	89	48	80	6	7	29	38	25	46
		Notonemouridae		6	14	3			2		1	2			
	Ephemeroptera	Leptophlebiidae		31	56	24	39	43	50	63	64	50	51	29	26
		Baetidae		1		18	35	53	59	51	63		3	27	61
	Odonata	Telephlebiidae						4	1					2	1
	Mecoptera				1										
Diptera		Chironomidae :													
		sub. fam. Chironominae		4	1	2		2	4	1	1	5	9	11	5
		sub. fam. Orthocladiinae		13	14	3	3	6	2	3	4	6		14	16
		sub. fam. Podonominae		1		10	15	15	14			7		3	7
		sub. fam. Tanypodinae		1		1						2	1		1
		Simuliidae		3	1		4	2	2	2		7	10	7	12
		Tipulidae		1							5	1			
		Athericidae			1	8			1		1	1			
		Ceratopogonidae					1	1	1					1	
		Unid. pupae		1		4	1	2	1			6			
	Trichoptera	Calocidae		2	3	1				3					
		Conoesucidae		3	2	25	45	22	6	30	19	38	26	6	9
		Helicophidae		1									4		
		Hydrobiosidae		17	17	13	8	6		36	20	2	3	14	6
		Hydropsychidae				3	1	4		22	11	7	13	19	1
		Hydroptilidae		1											
		Leptoceridae		1	1	3	4	3	1	4	13	3	1		3
		Philorheithridae			5	1				14	5		1		
		Unid. pupae													1
	Coleoptera	Adult Elmidae		12	18	11	4	6	3	22	6		1	1	1
		Larval Elmidae			4	4		2	1	6	2	3			
		Larval Scirtidae		8	12	6	6	17	14	20	8	6	3	2	1
		Larval Psephenidae		4	3			1		2	3	1		1	
Nematomorpha		Gordiidae									1				
			N Taxa :	25	23	25	17	20	21	20	21	23	17	18	20

Of the 15 species observed only in the reach of the Iris River of concern, all of them have been observed either within the WHA, close to the WHA or elsewhere, and none are considered rare or threatened.

A new species of leptophlebiid mayfly has been observed during this survey, found only at the upper Fall River site. Further taxonomic evaluation of this species is underway.

No threatened species issues in the Iris River have been brought to light by this survey and review.

However, the high diversity of the fauna in the Iris and Fall Rivers is noteable. The difference in the number of 'EPT' (mayfly, stonefly and caddis) taxa between the sites surveyed for this study and a set of 54 sites surveyed with a similar sampling effort in the southern forests (Davies et al. 2002, the only study within the state with which this data can be compared) is highly significant. These latter samples, all from good quality forest streams in the Huon-Esperance River catchments, also collected in autumn season, had a mean number of EPT taxa of 19 (range of 7 to 40). This is substantially lower than the mean of 36 taxa for the sites surveyed here ($p < 0.00001$ by t-test, assuming unequal variances). This supports a general view that the biodiversity of streams in the Cradle Valley area is unusually high (Davies, Jackson, Neboiss pers. comm.).

The biodiversity of the Iris River is therefore a significant regional feature. One which is in common with the Fall River, and the Dove River (as assessed from trapping of adult caddis, Neboiss pers. comm.), but which should be considered when managing water quality from the proposed discharge.

Qualitative samples

Results of the AUSRIVAS analysis of the RBA sample are shown in Table 6, presented as the mean O/Erk values from the two replicate samples collected at each site. All sites had O/E values that fell into the A or equivalent to reference band. This suggests little impact is occurring, but it should be noted that the state-wide AUSRIVAS models are not highly sensitive to the impacts of extensive grazing or

forest clearing (Davies et al. 2002), and that any pattern of variation in O/E should be examined carefully, independent of any band assignment. Thus, the two Fall River sites have the lowest mean O/E, while the Iris at Link Road had an intermediate value. This suggests that an impact from cattle grazing may be occurring at these sites, especially as substantial bank disturbance was noted in these river reaches.

Table 6. Values of O/Erk for sites surveyed in April 2003, and their assigned impairment bands.

River	Site	Mean O/Erk	Band
Iris	Upstream	1.00	A (equivalent to reference)
	Cradle Rd	0.98	A (equivalent to reference)
	Link Rd	0.91	A (equivalent to reference)
	Downstream	1.02	A (equivalent to reference)
Fall	Upstream	0.91	A (equivalent to reference)
	Downstream	0.91	A (equivalent to reference)

4. Conclusions

4.1 Conservation status

The conservation status of the Iris River at and downstream of the proposed point of wastewater discharge can be summarised by assessing its status against three criteria: distinctiveness, naturalness, and representativeness.

Distinctiveness

There are no threatened species issues of concern in the Iris. No listed or rare species of macroinvertebrates or fish or plant were detected, either in existing data, or in qualitative or quantitative samples collected from the study reach.

The sites all have high biodiversity, particularly of the 'EPT' taxa, which reflects a generally high biodiversity in this area. Thus, in a local context the sites are not distinctive, but are representative of a distinctive region in a statewide context. Care should be taken to protect this by adequate management of water quality in any discharge released.

The upper Fall River site is highly distinctive due to the presence of a new, undescribed species of leptophlebiid mayfly, discovered during this survey. It's presence at the only site where brown trout are absent suggests that this species may be susceptible to trout predation, and that trout may have had an impact on macroinvertebrate diversity in this area. This species is not present in the Iris River.

Naturalness

All sites in this study were assessed as having a good to high degree of naturalness, as represented by:

- the generally good condition of the stream channel, substrate and flows;
- the high O/E scores, which assessed the macroinvertebrates communities as essentially unimpaired;
- the presence of a wide range of macroinvertebrate taxa typical of relatively undisturbed conditions.

Several sites had signs of disturbance by cattle, which may have been reflected in the slightly lower O/E scores. This may be more significant during periods of low flow.

The presence of brown trout prevents these streams from being assessed as being in a natural state. Their abundance does, however, reflect good habitat and water quality conditions.

Representativeness

All sites had a fauna that was fairly representative of the area, and of a good quality stream environment. The biota of the Iris is not substantially different from other alpine streams in overall functional organisation and community composition (eg the streams of the Pelion Valley, Driessen et al. 1998).

In biological terms, the Iris River downstream of Cradle road has a moderate to high degree of naturalness, is not highly distinctive at the local level, but is distinctive at the state level, and is representative of other streams of its type.

4.2 Aquatic Biological Issues

The above assessment indicates that the only issue of concern with regard to the proposed discharge of wastewater is the high biodiversity of the Iris. Provided the Iris in nits upper reaches and tributaries remains well protected, and the Fall River is not degraded substantially, and given the protected status of the upper Dove River, then there are no substantial risks associated with discharge to the Iris downstream of the Cradle Road bridge. Water quality of the proposed discharge should, however, be high, and monitored on a regular basis. Care should especially taken to ensure adequate dilution during periods of low flow, or storage and discharge during periods of high flow.

5. References

Davies P, Cook L. 2002. Montreal Indicator R&D: Indicator 4.1f. Testing and refinement of AUSRIVAS for the detection, assessment and interpretation of changes in stream biodiversity associated with forestry operations. Report to Forest and Wood Products Research and Development Corporation , Freshwater Systems.

Driessen MM, Comfort MD, Jackson J, Balmer J, Richardson AMM, McQuillan PB 1998. WEBS. Pelion Plains – Mt Ossa. Wilderness Ecosystems Baseline Studies 1990-1993. Parks and Wildlife Service, Hobart Tasmania. Wildlife Report 98/2.

Dunn H 2000. Identifying and protecting rivers of high ecological value. Land & Water Resources Research & Development Corporation Occasional Paper No 01/00. Canberra 90 pp.